HUMAN FACE VERIFICATION UNDER ILLUMINATION VARIATION

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To

The Honorable Soul of My Father, whose Children's Success was His Only Wish.

To

My Kind Mother

To

My Beloved Wife and Son without their Support and Understanding It Would Have been Impossible to Achieve Such a Goal

To

The Respected Soul of My Previous Supervisor the Late Prof. Datuk.Dr. Marzuki Khalid Whom I Have Loved As a Father

And Last But Not Least, To

My Dear Brothers

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ABSTRACT

The appearance of a face will vary intensely when the illumination changes. The changes in the illumination conditions during image capturing make it difficult to obtain accurate face verification. Changes in illuminations results in two main problems, which are reflections and shadows. One of the most important aspects influencing the verification accuracy is illumination normalization. This thesis explored the use of fusion normalization methods to improve the performance of face verification under illumination variation. It has been shown that a single normalization technique is inadequate to solve the problems of illumination. In this study, several normalization methods such as Discrete Wavelet Transform, Discrete Cosine Transform, and Classified Appearance based Quotient Image were investigated for illumination normalization. A verification process was performed for each normalization technique and the outputs of the process, which were the likeness scores would be fused together to improve the final output. In the verification step, Principal Component Analysis was used to reduce the vector size of image and Linear Discriminant Analysis was used to extract discriminative information. In addition, un-trained fusion methods such as Max-Rule, Min-Rule, and Ave-Rule were used to get a unified decision with a reduced error rate. Besides that, fusion normalization methods were also used to solve all problems caused by illumination. The experiments were done on XM2VTS and Yale database B. The results of this research showed that the efficiency of Ave-Rule technique is better than other methods for XM2VTS, and the best fusion method for Yale database B is Min-Rule. To evaluate the techniques, the results have been compared with the outcomes of the fusion of each pair of the normalization methods as well as the results obtained from using other techniques. The comparison showed that the fusion of the three normalization techniques offered a better performance as compared to the fusion of two illumination normalization methods. Furthermore, the performance of face verification based on the fusion of the normalization methods was better in comparison to a single normalization technique.

ABSTRAK

Keketaraan penampilan wajah akan berbeza apabila wujudnya perubahan pencahayaan. Perubahan pencahayaan dalam merakam imej menyukarkan proses pengesahan muka dengan ketepatan yang baik. Perubahan pencahayaan akan menyebabkan dua masalah utama iaitu pantulan dan bayang-bayang. Normalisasi pengcahayaan adalah antara aspek penting yang mempengaruhi kualiti pengesahan. Tesis ini meneroka penggunaan kaedah gabungan normalisasi untuk meningkatkan kualiti pengesahan muka. Kaedah normalisasi tunggal tidak memadai dalam memperbaiki masalah ini secara amnya. Dalam kajian ini, beberapa kaedah normalisasi seperti Pengubah Wavelet Diskret, Pengubah Kosinus Diskret, dan Klasifikasi Rupa – berdasarkan Kadar Imej dianalisis dan digunakan sebagai kaedah normalisasi. Proses pengesahan dijalankan untuk setiap kaedah normalisasi dan proses outputnya adalah skor bandingan yang digabung bersama untuk memperbaiki keseluruhan output. Dalam langkah pengesahan, digunak Analisis Komponen Utama an untuk mengurangkan dimensi vektor maklumat imej, dan Analisis Diskriminasi Linear digunakan untuk mengoptimumkan maklumat diskriminatif. Di samping itu, kaedah gabungan tidak-terlatih seperti Peraturan-Maksima, Peraturan-Minima, dan Peraturan-Purata digunakan untuk mendapatkan keputusan bersatu dengan ralat dikurangkan. Selain itu, kaedah gabungan normalisasi juga digunakan untuk menyelesaikan masalah pengcahayaan. Eksperimen telah dijalankan pada XM2VTS dan Pangkalan Data Yale B. Keputusan menunjukkan kaedah Peraturan-Purata adalah terbaik berbanding kaedah lain untuk XM2VTS, dan gabungan Peraturan-Minima adalah terbaik untuk Pangkalan Data Yale B. Keputusan daripada kaedah yang dicadangkan akan dibandingkan dengan setiap kaedah gabungan normalisasi dan beberapa kaedah lain. Kualiti pengesahan dengan gabungan tiga kaedah normalisasi adalah lebih baik berbanding gabungan dua kaedah normalisasi. Di samping itu, pengesahan muka dengan kaedah gabungan normalisasi juga adalah lebih baik berbanding kaedah normalisasi tunggal.